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(54) **Method of forming a patterned photopolymer coating on a printing roller and also a printing roller with patterned photopolymer coating.**

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FR-A-2 158 869
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Description

BACKGROUND OF THE INVENTION

The invention relates to a method of forming a patterned photopolymer coating on a printing roller in which a removable light-sensitive, seamless intermediate layer, applied to the photopolymer layer and adhering closely thereto, is exposed and optionally developed in a first stage essentially to form a desired patterned opaque image in said intermediate layer and subsequently the photopolymer layer is exposed via the image formed in the intermediate layer, after which exposure the opaque intermediate layer parts and the soluble parts of the photopolymer layer are removed.

A method of the type described is known from FR-A-2 158 869. From said publication is known a method for the forming of a printing plate in which a substrate is covered with two photosensitive layers on top of each other. The top layer has a relatively high photosensitivity whereas the bottom layer has a relatively low photosensitivity.

The top layer is then exposed by means of an adequate beam of radiation, to form a pattern. Said pattern, after development, serves as a mask in the subsequent overall exposure to allow for action of light of a suitable wavelength on those parts of the bottom layer which are not covered by the mask. After the second exposure, the bottom layer is developed, if necessary after removal of the mask. This known method has as a disadvantage that the equipment which is needed for the first exposure, is rather complicated and expensive. If in the type of layer system as described in the mentioned French document a patterning film is used for the first exposure a number of problems arise due to the fact that such film is applied with pressure. In this state exposure is then carried out, whereafter the patterning film is removed.

The patterned printing roller is produced thereafter by washing out the soluble parts of the photopolymer coating present after the exposure.

In the case of photohardening polymer these are the unexposed parts.

In the case of photodecomposable polymer these are, however, the exposed parts.

Unwinding the patterning film along a rotating roller coated with a photopolymer layer and exposing at the position of the contact surface through a slit are also known.

In this known method, both when photohardening and when photodecomposable photopolymer coatings are used, imperfections in the patterning occur at the point of contact of the pattern, as a result of which the printing result at the position is influenced unfavourably.

In the case of a photohardening polymer and a patterning film with overlapping edges the photopolymer layer, which is still somewhat elastic before exposure, is somewhat dented at the position of the overlap, which dent is fixed at the position of exposed parts by hardening.

In the case of a patterning film with abutting edges the light will be scattered or reflected at the position of the said edge by the transparent parts of the pattern in the patterning film, as a result of which incomplete light transmission is brought about at the position. On the other hand, at the position of the said edge some light will nevertheless be transmitted through the parts not intended to transmit light (i. e. black) of the pattern in the patterning film.

Both in the case of photohardening and in the case of photodecomposable photopolymer the phenomenon occurs at the position of the abutment edge that in the case of hard parts some material may nevertheless be washed away and that in the case of soft parts which can be washed out less is removed.

In the case of unwindable patterning film and slit exposure a double exposure always takes place at the junction of the pattern as a result of the slit width of the exposure slit, as a result of which the slope formation between exposed and unexposed parts of the polymer layer is influenced and deviations are produced as a result of the slope formation for single exposure in the rest of the pattern for both photohardening and photodecomposable photopolymer coating.

SUMMARY OF THE INVENTION

A primary object of the invention is now to provide a method for obtaining a patterned printing roller with photopolymer coating without a longitudinal zone having deviations in height, depth and slope formation of the patterning.

The above-mentioned object is achieved according to the invention in that the photopolymer layer, having a thickness of 1 - 10 mm, is exposed in a first stage via a patterning film which is pressed against said intermediate layer while after the first stage the patterning film is removed and exposure of said photopolymer layer is postponed until depressed parts of the photopolymer layer which are created at the site of overlapping parts of the pattening film used in said first stage, have returned to the original state.

A flexible photopolymer layer is generally having a thickness from 1 to 10 mm; preferably a thickness from 2 to 5 mm is used.

In this manner a photopolymer coating pattern is obtained on a printing roller.

To obtain the desired image information in the seamless intermediate layer without substantial conversion of the parts of the photopolymer coating present below the said seamless intermediate layer, it may be advisable to apply a light filter layer between the light-sensitive intermediate layer and the photopolymer layer surface.

In this manner it is possible to ensure that

during the first exposure an image is only formed in the light-sensitive intermediate layer.

The light filter layer is expediently applied seamlessly to the photopolymer layer surface.

The light-sensitive intermediate layer may be a layer based on, for example, a diazo compound, a silver halide or a light-sensitive polymer and may be applied by spraying on, spreader coating or transfer coating.

The light-sensitive intermediate layer is expediently much more sensitive to a certain exposure than the photopolymer layer. Particularly good results are obtained if light of different wavelengths is used for the exposure in the first and second step. Light of the same wavelength can also be used for the exposure in the first and the second step, in which case, however, the intermediate layer is then much more sensitive to said light of a certain wavelength than the photopolymer layer.

The invention also relates to a printing roller with patterned photopolymer coating formed by exposure of the photopolymer coating via a patterning film pressed against the photopolymer coating, followed by removal of the patterning film and of soluble parts of the photopolymer coating which is characterized according to the invention in that the photopolymer coating obtained after washing out is free of a longitudinal zone of insoluble photopolymer parts having a lower clearance height and/or having different side widths than other comparable insoluble photopolymer parts.

In this case, by clearance height is meant the distance between the uppermost face of the insoluble polymer parts and the surface of an adjacently located recess.

As the result of the absence of insoluble photopolymer parts with a top face which does not lie on a cylindrical surface which includes the surfaces of the other insoluble photopolymer parts, the printing result of a printing roller of this type is considerably improved in comparison with the known printing roller.

If a photodecomposable photopolymer coating is used, the surfaces of the insoluble photopolymer parts lie on a cylindrical surface, while next to these photopolymer parts a polymer layer of the same thickness is at most always present in the recesses. This results likewise in a better printing result.

The same applies to photopolymer parts which all have virtually the same side width.

SURVEY OF THE DRAWINGS

- Figure 1 shows a section of a printing roller during its manufacture;
- Figure 2 shows a printing roller with photopolymer coating of the photohardening type and a depressed part of the photopolymer coating;
- Figure 3 shows the same photopolymer coating after restoration to the original state;
- Figure 4 shows a section of a photopolymer coating of the photohardening type with light-sensitive intermediate layer and a patterning film, the edges of which are up against each other in an abutting manner;
- Figure 5 shows a part of the surface of the printing roller with hardened parts of the photopolymer layer after washing out;
- Figure 6a shows the sides of the hardened parts of the photopolymer layer in the case of a printing roller according to the invention and obtained by the method of the invention;
- Figure 6b shows the same hardened parts obtained with a double exposure;
- Figure 7a shows a part of the surface of the printing roller on using a patterning film the edges of which lie against each other in an abutting manner obtained without a light-sensitive intermediate layer with a photodecomposable polymer;
- Figure 7b shows the same surface obtained with a light-sensitive intermediate layer.

DESCRIPTION OF THE PREFFERED EMBODIMENTS

In Figure 1 a metal printing roller 1 is shown provided with a photopolymer coating of the photohardening type 2 of uniform thickness applied thereto.

On the surface of the photopolymer coating 2 there is applied a seamless light-sensitive intermediate layer 3 of a silver halide emulsion applied by means of a spreader. The light-sensitivity of this silver halide emulsion layer is approximately 100 times as great as that of the photopolymer coating. In general light-sensitive intermediate layers are employed which are approximately 3 to 200 times as sensitive as the light-sensitivity of the photopolymer coating.

Around the printing roller 1 with photopolymer coating layer 2 and light-sensitive intermediate layer 3 applied thereto there is applied a patterning film 4, the edges 7 and 8 of which overlap each other to form overlapping sections 4a and 4b. The whole is wrapped around with a transparent film layer 5 of a plastic material (such as polyvinyl chloride film) and a vacuum is then created under the said film layer 5. As a result of this the patterning film 4 will be pressed against the surface of the somewhat elastic photopolymer coating 2. At the position of the overlapping parts 4a and 4b this results in depression 6 of the photopolymer layer.

If the light-sensitive intermediate layer 3 were not to be employed, exposed sections of the photohardening photopolymer layer in the depressed region would be hardened, as a result of which impressions would be fixed locally in a narrow transverse zone over the width of the patterning (see surface 14 in Figure 5).

By making use of the light-sensitive intermediate layer 3, during exposure essentially only an image of the patterning film is transferred to the said light-sensitive layer 3. After removal of the patterning film and of the wrapping film 5 a state is obtained such as shown in Figure 2 in which the light-sensitive intermediate layer 3 has exposed parts 13 and unexposed parts 15 in accordance with the pattern, the pattern, depending on the type of light-sensitive layer, having already been formed or being present as a latent image which becomes visible after development.

After a short time the depressed section 6 of the photohardening photopolymer layer will return to its original state, as a result of which the state as shown in Figure 3 is obtained.

Exposure is then carried out for a second time, in which process parts 10 of the photopolymer layer 2 are hardened. After removal of the light-sensitive layer and unhardened parts of the photopolymer layer a printing roller with a pattern formed from the hardened photopolymer layer parts 10 is obtained.

In Figure 4 another embodiment is shown in which the edges 7 and 8 of the patterning film 4 fit against each other in an abutting manner. In that case no depression of the elastic photohardening photopolymer layer 2 occurs, but as a result of scattering the photopolymer parts to be exposed at the position of the abutting edges will be less exposed than other parts exposed to the same quantity of light. On washing out the photopolymer layer these polymer parts at the position of the abutting edges will also be washed out to some extent so that parts with a lower height than other parts will be obtained at that point (see surface 14 in Figure 5).

In the case of a photodecomposable photopolymer layer parts to be exposed at the position of the abutment edge will also receive too little exposure, with the result that washing out takes place to a shallower depth. This is shown in Figure 7a wherein 10 represents the unexposed parts and 18 the exposed parts if no light-sensitive intermediate layer is used.

Figure 7b shows the result if a light-sensitive intermediate layer is in fact used.

In both the abovementioned cases the light-sensitive intermediate layer 3 offers the great advantage that these difficulties can be eliminated.

As already stated, the manufacturing of a printing roller with a pattern by rotating the roller bearing the photopolymer layer and unrolling the patterning film along the said rotating roller while exposing through a slit is also already known. At the joint of the pattern a double exposure always takes place under these circumstances as a result of the slit width. In Figure 6a a photopolymer layer part 10 hardened by a single exposure is shown with sides 11 and 12 which slope fairly steeply. With a double exposure of the same photopolymer layer part a hardened section 10' with sides 11' and 12', which slope much more gently, is obtained so that a greater side width is obtained in comparison with the embodiment according to Figure 6a. This is avoided by a light-sensitive intermediate layer according to the invention.

The following example explains a certain embodiment.

Example

To a printing roller 1 with a diameter of 50 cm a photopolymer coating layer 2 of, for example, Cyrel (Dupont) is applied by means of a spreader coating or by a sheet of this material wrapped around it, which is then fused together and accurately processed to obtain the correct diameter and roundness.

To the photopolymer layer a silver emulsion layer is applied as light-sensitive intermediate layer 3.

Around the whole a patterning film 4 is then applied in the manner as shown in Figure 1 and then a wrapping film 5 of polyvinyl chloride, whereafter evacuation is carried out under the wrapping film 5 so that the patterning film is pressed against the photopolymer coating with light-sensitive layer.

Exposure is first carried out with light of a wavelength of 400 - 440 nanometers.

The wrapping film 5 and the patterning film 4 are then removed and the light-sensitive intermediate layer 3 is developed, as a result of which the image corresponding to that of the patterning film is formed therein.

After standing for some time, optionally in combination with a heat treatment, the seam has disappeared from the photopolymer coating 2, exposure is carried out a second time with light having a wavelength of 340 to 380 nanometers.

The remaining sections of the light-sensitive intermediate layer 3 originally applied and the unexposed parts of the photopolymer layer are then removed to a certain depth by washing out.

In order to limit the effect of the first exposure essentially to the light-sensitive intermediate layer 3 a filter layer 16 of a tinuvin compound (Ciba Geigy) which absorbs ultraviolet light can be applied with advantage between intemediate layer 3 and photopolymer coating 2.

Claims

1. Method of forming a patterned photopolymer coating on a printing roller (1) in which a removable light-sensitive, seamless intermediate layer (3), applied to the photopolymer layer (2) and adhering closely thereto, is exposed and optionally developed in a first stage essentially to form a desired patterned opaque image in said intermediate layer (3) and subsequently the photopolymer layer (2) is exposed via he image formed in the intermediate layer, after which exposure the opaque intermediate layer parts (3)

and he soluble parts of the photopolymer layer (2) are removed characterized in that the photopolymer layer (2), having a thickness of 1 - 10 mm, is exposed in the first stage via a patterning film (4) which is pressed against said intermediate layer (2), while after the first stage the patterning film (4) is removed and exposure of said photopolymer (2) is postponed until depressed parts of the photopolymer layer, which are created at the site of overlapping parts of the patterning film (4) used in said first stage, have returned to the original state.

2. Method according to claim 1, characterized in that for the exposure in the first and the second step light of different wavelength regions is used.

3. Method according to claims 1 or 2, characterized in that for the exposure in the first and the second step light of the same wavelength region is used.

4. Method according to one or more of the claims 1 - 3, characterized in that the light-sensitive intermediate layer (3) is more sensitive to light of a certain wavelength region than the photopolymer coating (2).

5. Method according to one or more of the preceding claims, characterized in that a light filter layer (16), preferably seamless, is applied between the light-sensitive intermediate layer (3) and the surface of the photopolymer coating (2).

6. Printing roller with patterned photopolymer coating obtained by the method of claim 1 characterized in that the photopolymer coating obtained after washing out is free of a longitudinal zone of insoluble photopolymer parts having a lower clearance height and/or having a different side width than other comparable insoluble photopolymer parts.

Patentansprüche

1. Verfahren zur Herstellung einer photopolymerisierbaren Bildschicht auf einer Druckwalze (1), indem eine entfernbare lichtempfindliche, nahtlose Zwischenschicht (3) auf die photopolymerisierbare Schicht (2) aufgebracht wird und eng an dieser haftet, belichtet und wahlweise in einer ersten Stufe entwickelt wird, die im wesentlichen zur Ausbildung eines gewünschten undurchsichtigen Bildes in der genannten Zwischenschicht (3) dient, und anschließend die photopolymerisierbare Schicht (2) durch das in der Zwischenschicht gebildete Bild belichtet wird und nach dieser Belichtung die undurchsichtigen Zwischenschichtteile (3) und die löslichen Teile der photopolymerisierbaren Schicht (2) entfernt werden, dadurch gekennzeichnet, daß die photopolymerisierbare Schicht (2) mit einer Dicke von 1 - 10 mm in der ersten Stufe durch den auf die genannte Zwischenschicht (3) aufgepreßten Bildfilm (4) hindurch belichtet wird, während nach der ersten Stufe der Bildfilm (4) entfernt und die Belichtung des genannten Photopolymers (2) verzögert wird, bis die eingedellten Teile der photopolymerisierbaren Schicht, die an der Stelle der überlappenden Teile des in der ersten Stufe verwendeten Bildfilms (4) entstehen, in den ursprünglichen Zustand zurückgekehrt sind.

2. Verfahren gemäß Anspruch 1, dadurch gekennzeichnet, daß für die Belichtungen in der ersten und zweiten Stufe Licht unterschiedlicher Wellenlängenbereiche benutzt wird.

3. Verfahren gemäß Anspruch 1 oder 2, dadurch gekennzeichnet, daß für die Belichtungen in der ersten und zweiten Stufe Licht des gleichen Wellenlängenbereichs benutzt wird.

4. Verfahren gemäß einem oder mehreren der Ansprüche 1 bis 3, dadurch gekennzeichnet, daß die lichtempfindliche Zwischenschicht (3) in einem bestimmten Wellenlängenbereich lichtempfindlicher als die photopolymerisierbare Schicht (2) ist.

5. Verfahren gemäß einem oder mehreren der vorstehenden Ansprüche, dadurch gekennzeichnet, daß eine vorzugsweise nahtlose Lichtfilterschicht (16) zwischen der lichtempfindlichen Zwischenschicht (3) und der Oberfläche der photopolymerisierbaren Schicht (2) aufgetragen wird.

6. Druckwalze mit einer gemäß Verfahren nach Anspruch 1 hergestellten photopolymeren Bild, dadurch gekennzeichnet, daß die nach dem Auswaschen erhaltene photopolymere Schicht frei von einer länglichen Zone unlöslicher Photopolymerteile mit kleinerer lichter Höhe und/oder einer anderen Seitenbreite als vergleichbare andere unlösliche Photopolymerteile ist.

Revendications

1. Procédé de formation d'une couche photopolymère imprimée sur un cylindre d'impression (1), dans lequel une couche intermédiaire (3) amovible sensible à la lumière et sans raccord, appliquée sur la couche photopolymère (2) et adhérant étroitement à celle-ci, est exposée et éventuellement développée au cours d'une première phase, en particulier pour former le motif désiré d'une image opaque dans ladite couche intermédiaire (3) et ensuite, la couche photopolymère (2) est exposée à travers l'image formée dans la couche intermédiaire, les parties opaques de la couche intermédiaire (3) et les parties solubles de la couche photopolymère (2) étant ensuite éliminées, caractérisé en ce que la couche photopolymère (2) de 1 à 10 mm d'épaisseur est exposée, au cours d'une première phase à travers un film d'impression de motif (4) appliqué contre ladite couche intermédiaire (3) et que, après la première phase, le film d'impression de motif (4) est enlevé et l'exposition dudit photopolymère (2) est retardée jusqu'à ce que les parties déprimées de la couche photopolymère, présentes à l'endroit du chevauchement de certaines portions du film d'impression de motif (4) aient repris leur état d'origine.

2. Procédé selon la revendication 1, caractérisé en ce qu'on utilise, pour l'exposition de la première et deuxième opération, des lumières de longueurs d'onde différentes.

3. Procédé selon les revendications 1 ou 2, caractérisé en ce qu'on utilise pour l'exposition au cours de la première et de la deuxième opération, une lumière de même longueur d'onde.

4. Procédé selon l'une ou plusieurs des revendications 1 à 3, caractérisé en ce que la couche intermédiaire (3) sensible à la lumière est plus sensible à une lumière dont la longueur d'onde est située dans une certaine région du spectre que la couche photopolymère (2).

5. Procédé selon l'une ou plusieurs des revendications précédentes, caractérisé en ce qu'on applique une couche (16) filtrant la lumière, et de préférence sans raccord, entre la couche intermédiaire (3) sensible à la lumière et la surface de la couche photopolymère (2).

6. Cylindre d'impression muni d'une couche photopolymère imprimée, obtenu par le procédé de la revendication 1, caractérisé en ce que la couche photopolymère obtenue après élimination par lavage ne présente pas une zone de parties photopolymères insolubles ayant une hauteur libre inférieure et/ou de largeur latérale différant d'autres parties photopolymères insolubles.

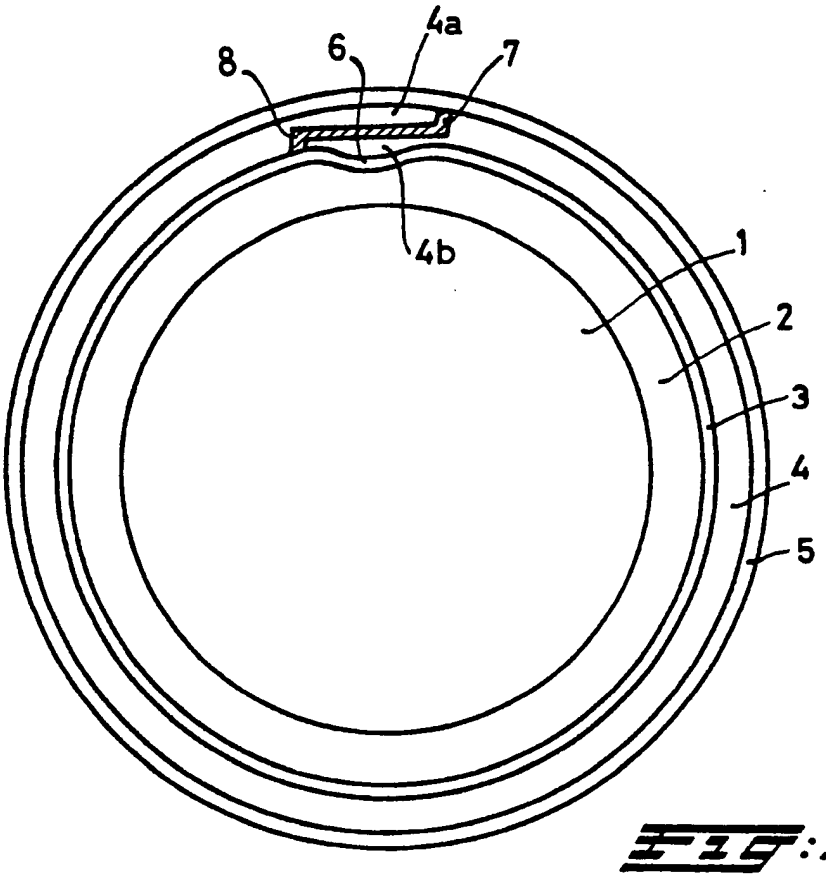

Fig: 1.

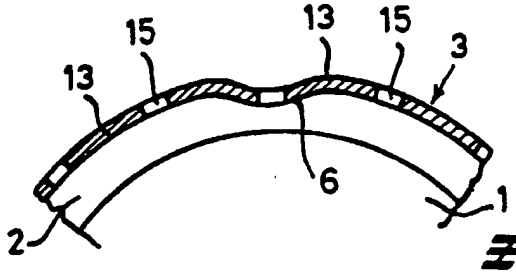

Fig: 2.

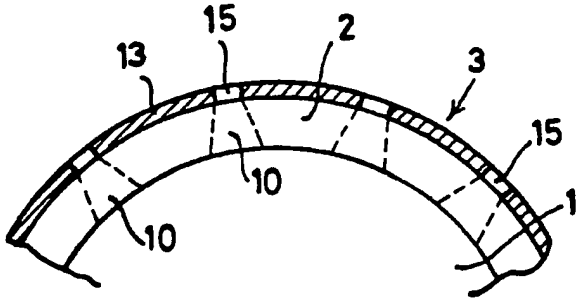

Fig: 3.

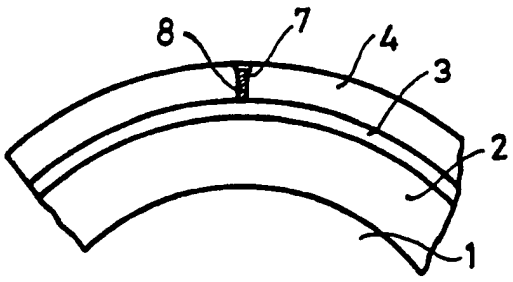

Fig: 4.

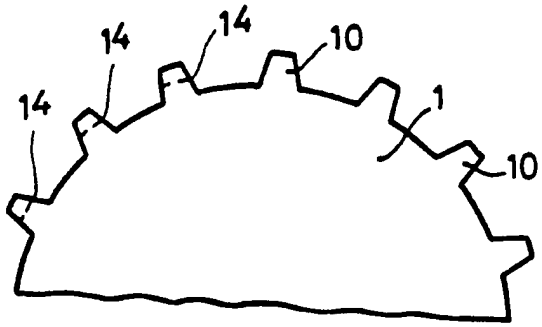

Fig: 5.

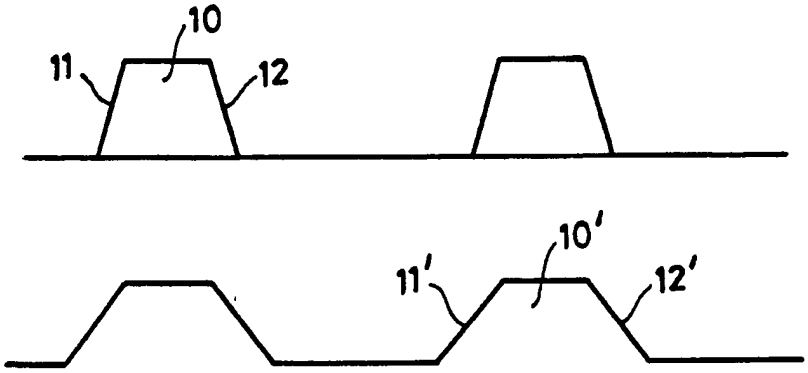

Fig: 6.

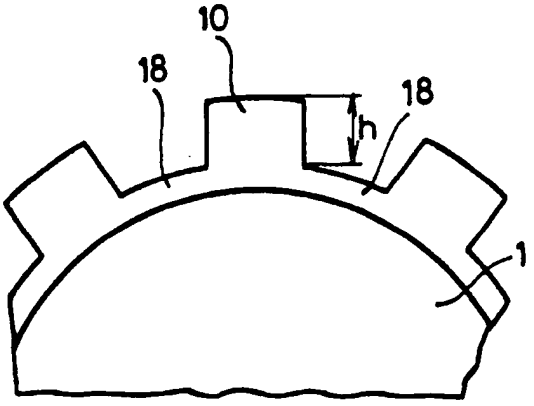

Fig: 7a.

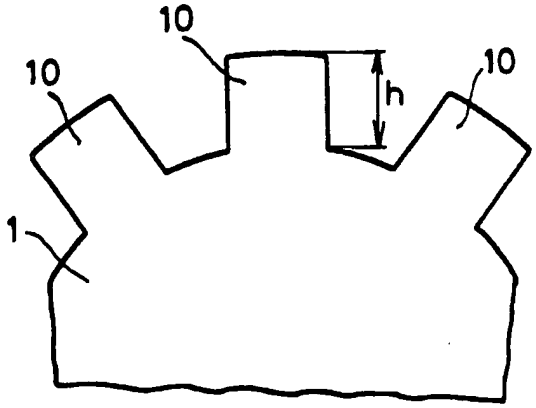

Fig: 7b.